Center Innovation Fund: GSFC CIF

A Low G Ideal Integrating Bolometer

Completed Technology Project (2014 - 2016)

Project Introduction

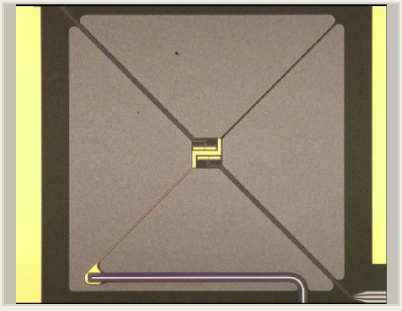
We propose to develop a novel detector to enable a new class of far-IR spectroscopic surveys. Achievable sensitivity for these devices is roughly 2 orders of magnitude better than current devices. By reducing detection times by a factor of 10 000, the IIB enables rapid surveys of cosmological volumes to leapfrog the performance of planned missions.

Developments in far-infrared spectroscopy promise to open a new window to the early Universe. Atomic lines in the far-IR are the dominant cooling mechanism for the interstellar medium. A significant fraction of the total bolometric luminosity of a typical star-forming galaxy is emitted in these lines, allowing observations at cosmological distances. The frequency range 300 GHz to 3 THz probes the fine structure lines from important chemical species (C, O, N) at redshifts $z < 6$, providing a critical test of galaxy assembly and formation to trace star formation activity across cosmic time scales. Detecting these lines from more than a handful of sources requires dramatic improvements in sensitivity. Detecting individual lines while avoiding confusion or line blending requires detector sensitivity below 10^{-19} W $Hz^{-1/2}$ and spectroscopic resolution lambda/delta lambda > 1000. Even at these levels, detections will take hours or days of integration for a single beam spot on the sky, severely limiting the possibilities for cosmological surveys.

The proposed Ideal Integrating Bolometer (IIB) is able to achieve dramatic improvement in sensitivity because it has two time constants: an extremely long time constant over which signal is collected, and a very short one that allows rapid reset. A non-dissipative device reads out temperature. Without thermometer dissipation, temperature rise is due only to absorbed optical power. Thus, temperature rise over the period between resets is proportional to the integrated photon flux. The off state conductance can be made very small, limited only by the achievable on/off ratio of the switch, greatly enhancing the sensitivity. Signal loss due to a cosmic ray hit is limited to the reset period.

Anticipated Benefits

The project will enable far-infrared detector with greatly improved sensitivity. It may also be benefical in improving the sensitivity of other thermal detectors, such as x-ray microcalorimeters.



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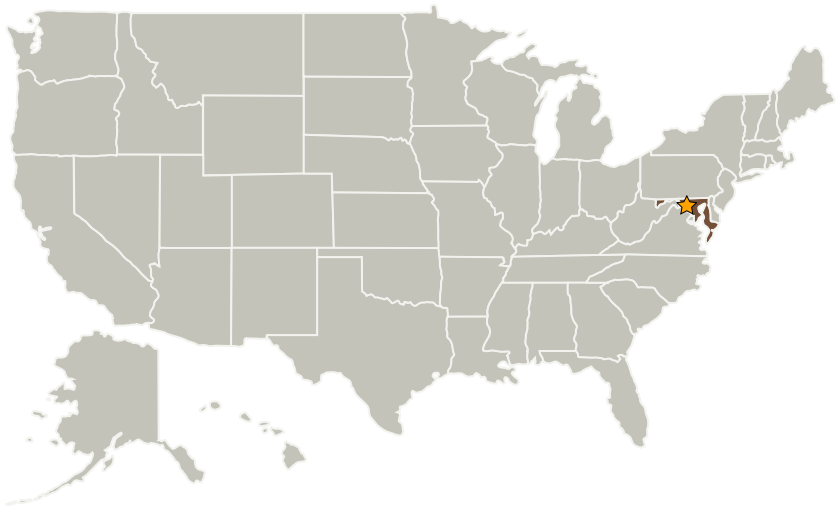
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Goddard Space Flight Center(GSFC)	Lead Organization	NASA Center	Greenbelt, Maryland

Primary U.S. Work Locations
Maryland

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Goddard Space Flight Center (GSFC)

Responsible Program:

Center Innovation Fund: GSFC CIF

Project Management

Program Director:

Michael R Lapointe

Program Manager:

Peter M Hughes

Project Manager:

Terence A Doiron

Principal Investigator:

Edgar R Canavan

Co-Investigators:

Alan J Kogut
Thomas R Stevenson

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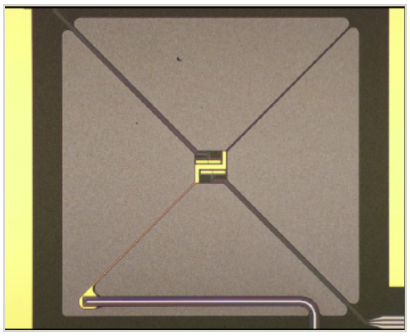
Images



Ideal Integrating Bolometer
Ideal Integrating Bolometer
(https://techport.nasa.gov/image/16630)

Links

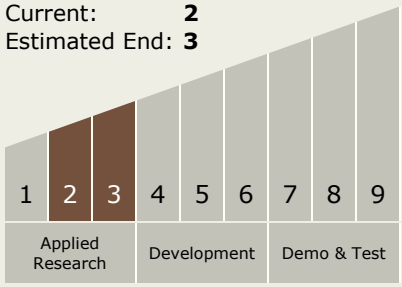
NTR 1438372222
(no url provided)

Project Website:

http://sciences.gsfc.nasa.gov/sed/

Technology Maturity (TRL)

Start: **2**
Current: **2**
Estimated End: **3**



Technology Areas

Primary:

- TX08 Sensors and Instruments
  - TX08.1 Remote Sensing Instruments/Sensors
    - TX08.1.1 Detectors and Focal Planes